(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 433 974 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **90124573.8**

(51) Int. Cl.5: **B29D 30/36**

(22) Date of filing: **18.12.90**

The title of the invention has been amended (Guidelines for Examination in the EPO, A-III, 7.3).

(30) Priority: **19.12.89 IT 2273089**

(43) Date of publication of application: **26.06.91 Bulletin 91/26**

(84) Designated Contracting States: **AT BE CH DE DK ES FR GB GR LI LU NL SE**

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(54) Method and apparatus for making tyres having a high transversally curved toric profile.

(57) The invention refers to the manufacture of a pneumatic tyre having a toric profile at high transversal curvature wherein the reinforcing annular structure (5) and the tread band (4) are shaped together, starting from a cylindrical configuration to the final toric profile, in a single shaping step, before being assembled to the carcass, the step for vulcanizing the pneumatic tyre being carried out without requiring a further shaping of the pneumatic tyre.

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PROCESS FOR MANUFACTURING PNEUMATIC TYRES HAVING A TORIC PROFILE AT HIGH TRANSVERSAL CURVATURE, APPARATUS FOR ITS MANUFACTURE AND PRODUCT SO OBTAINED

The present invention refers to the process for manufacturing pneumatic tyres having a toric profile at high transversal curvature, comprising a carcass, a tread band and a reinforcing annular structure, also known as belt, inserted between said carcass and said tread band.

Particularly, the invention concerns processes for preparing the carcass separately from the assembly constituted by the reinforcing annular structure and the tread band and for transferring then said assembly onto the carcass for assembling and torically shaping the whole pneumatic tyre.

As known, the pneumatic tyres having a high transversal curvature are those especially suitable for equipping two-wheelers, which run on cornering with camber angles even of the order of 50° or 60°, values impossible to reach with the conventional pneumatic tyres for motorvehicles having a sensibly flat transversal profile.

In the manufacture of these pneumatic tyres having a high transversal curvature it is known a process comprising the steps of preparing the reinforcing annular structure separately from the carcass by radially superimposing layers of rubberized fabric reinforced with mutually crossed cords, in a known way, and of superimposing a tread band upon this reinforcing structure, before being assembled to the carcass.

More in detail, these pneumatic tyres are usually manufactured by preparing the carcass on a suitable expansible building drum, in cylindrical configuration, bringing then the configuration of the carcass to a first toric shape. Then two coaxial hollow supports are drawn near the carcass sidewalls, said supports having a radially outer cylindrical surface (the well known bells) and a diameter like that of the carcass in the above said first toric shape. By means of said supports it is possible to arrange on said carcass, at its centre line left free by the bells, in flat configuration and for subsequent steps, the reinforcing layers and the tread band, making them adhere the one to the other and to the carcass centre line portion by stitching of the central portion of the assembly constituted by the reinforcing layers and the tread band.

At this stage the above said bells are moved away and the lateral zones of the assembly are stitched so as to make the remaining portions (lateral) of the reinforcing layers and tread band adhere to the carcass, which meanwhile is shaped according to a second toric configuration.

The so obtained green tyre is therefore inserted into the vulcanizing mould where it suffers a further shaping consisting in an increase of the circumferential development of the tyre of about 5%, during which the tread pattern is printed on the tread band.

A second known process consists in preparing the carcass in the form of a cylindrical sleeve on a main expansible drum, preparing on a separate ancillary drum the reinforcing annular structure, expanding said ancillary drum as far as to bring said reinforcing annular structure to a first toric configuration, applying the tread band on the so shaped annular structure stitching it with suitable means in order to provide it with the same toric configuration as the above said annular structure, transferring the assembly constituted by structure and tread band in correspondence of the carcass mid-plane, coaxially to the same, and expanding the above said carcass to the same toric configuration as the assembly in order to realize the assembling of the two elements and consequently the green tyre to be vulcanized.

This process and the relative apparatus are described in the Italian patent No. 1,099,513 of the same Applicant.

Also in this case there takes place the vulcanization of the pneumatic tyre in the conventional way, after having brought the above said pneumatic tyre to its final toric shaping inside the mould.

The above said processes arise different difficulties and problems owing to the stitching operation exerted on the tread band and to the final configuration carried out inside the mould, which turn into a product that does not correspond to the qualitative characteristics required; in fact, the stitching is a very strong operation that causes deformations in the tread band with transfer of elastomeric material from the centre towards the ends of the band (in this operative step the band is still in the green state, i.e. plastic state) as well as uncontrollable and undesired angular variations of the reinforcing cords of the belt layers and also of those of the carcass plies, both when the stitching is carried out after the assembling of the annular element (belt/tread assembly) to the carcass, and during the shaping inside the mould: all these drawbacks produce a qualitative decadence of the pneumatic tyre, today no more tolerable in view of the high performance required not only in the agonistic uses, but also in less exasperated ones as the normal tourist use.

Therefore the aim of the present invention is that of solving the problems of the known technique by realizing a process for manufacturing pneumatic tyres having a toric profile at high transversal curvature, which enables to control the variation of the geometric characteristics of the pneumatic tyre structure, in

particular the lying angles of the reinforcing cords of the belt layers along the whole longitudinal development of the cords, from one end to the other of the layer, in consequence of which the conditions of the vulcanized tyre are those foreseen at the beginning and especially the above said angles are those defined by the plan.

Therefore, according to a first aspect, the present invention refers to a process for manufacturing pneumatic tyres having a toric profile at high transversal curvature, provided with a carcass, a tread band put as a crown on said carcass and a reinforcing annular structure, interposed between said carcass and said tread band (in particular radially superimposed layers of rubberized fabric provided with reinforcing cords inclined with respect to the circumferential direction of the pneumatic tyre, parallel to each other in any layer and crossing those of the adjacent layers), said process comprising the steps of preparing separately the one from the other said carcass, said tread band and said reinforcing annular structure, of associating to said carcass an annular element comprising said reinforcing annular structure and said tread band, assembled together and already torically shaped, realizing in such a way a complete green pneumatic tyre and of vulcanizing said green pneumatic tyre inside the mould, said process being characterized by the fact of assembling said tread band to said reinforcing annular structure before the shaping step, so as to have said annular element in a cylindrical configuration, and of shaping said annular element according to its final toric configuration, at high transversal curvature, before being assembled to said carcass.

According to another aspect the present invention refers to a pneumatic tyre for vehicle wheels, of the type having a toric profile at high transversal curvature, provided with a carcass, a tread band put as a crown on said carcass and a reinforcing annular structure, interposed between said carcass and said tread band (in particular comprising radially superimposed layers of rubberized fabric provided with reinforcing cords inclined with respect to the circumferential direction of the pneumatic tyre, parallel to each other in any layer and crossing those of the adjacent layers), characterized by the fact that the inclination angle of said reinforcing cords, in the vulcanized pneumatic tyre is comprised between 10° and 35°, the value of said angle at the mid-plane being lower than the value taken on at the ends of said reinforcing annular structure.

In particular the present invention concerns the pneumatic tyre referred to above obtained by means of the process according to the invention.

According to a further aspect the present invention refers to a machine for manufacturing pneumatic tyres having a toric profile at high transversal curvature, provided with a carcass, a tread band put as a crown on said carcass and a reinforcing annular structure, interposed between said carcass and said tread band, said machine comprising a main drum for shaping a carcass of cylindrical configuration into a toric configuration, an ancillary drum for building-up and shaping said reinforcing annular structure, said ancillary drum comprising a cylindrical drum of predetermined diameter for building-up said annular structure according to a cylindrical configuration and an expansible drum for the subsequent toric configuration of said annular structure, said expansible drum comprising a plurality of sectors having a radially outer toric profile, movable in radial direction for coupling with the radially inner surface of said annular structure, and for its toric configuration, and means for transferring at least said reinforcing annular structure from said expansible drum, coaxially around said carcass, onto said main drum, said machine being characterized by the fact that said radially movable sectors have said outer profile substantially corresponding to the toric profile at high transversal curvature of the radially inner surface of the vulcanized pneumatic tyre.

Preferably, the radially outer toric profile of the above said sectors has a swelling comprised between 0.20 and 0.35.

However, the present invention will be better understood by the following description made by way of non-limiting example, with reference to the attached sheets of drawing in which:

FIGURE 1 - is a cross section of a radial tyre having a high transversal curvature, manufactured by means of the process according to the invention, in a plane containing the axis of rotation of the tyre;

FIGURE 2 - shows a portion of the reinforcing annular structure, stressing the lying angle of the cords of the layers during the flat shaping (in cylindrical configuration) of the above said structure;

FIGURE 3 - shows the same portion of reinforcing annular structure on the vulcanized pneumatic tyre, stressing the angular variations occurred in the lying of the above said cords;

FIGURE 4 - is a plant for manufacturing the pneumatic tyre of figure 1;

FIGURE 5 - shows the toric profile at high transversal curvature of the radially expansible sectors used for shaping the above said annular element;

FIGURES 6 AND 7 - show the steps of the process for manufacturing a pneumatic tyre according to the invention in comparison with the process steps carried out according to the previously known technique.

With reference to figure 1, the following description illustrates the most general type of radial tyres to which the invention results to be particularly applicable.

When the manufacture has been completed, the shown tyre comprises a radial carcass 1 formed by one or more rubberized plies whose ends turn-up, the whole in a way per se known, around the bead cores 2, provided in a radially outer position with a filling 3 of high hardness elastomeric material. A tread band 4, inside which the tread pattern has been printed, is put as a crown on said carcass, and a reinforcing annular structure 5, usually well known as belt, is inserted between said tread band 4 and said carcass 1.

The above said belt, as wide as the tread, comprises at least one, but more generally two layers 6, 7 of rubberized fabric provided with reinforcing cords 8 (figure 2) inclined with respect to the equatorial plane of the pneumatic tyre (center line m-m) of an angle comprised between 10° and 35°, in the example shown equal to 22°, parallel to each other in each layer and crossing those of the adjacent layer or layers.

Very conveniently the above said cords may be of any suitable material, for instance nylon, kevlar (registered trademark of Du Pont), steel, etc.

Of course the belt can comprise other reinforcing layers, well known in the technology of the pneumatic tyres and therefore not mentioned here without however affecting negatively the understanding of the invention.

The shown tyre has a toric profile at high transversal curvature, i.e. it has a very winding tread, with an accentuated curvature at the crown, ending with two sharp edges at the ends, in the jointing zone with the sidewalls. The purpose of these sharp edges is that of notifying the driver the reaching of the limit camber angle before the vehicle loses stability and road holding.

The above said curvature is usually given by means of the arrow "f", i.e. of the ratio h/1, where h represents the radial height of the tread, measured at the mid-plane and with reference to line "r" (figure 1) passing through the edges of the tread and in case also tangent to the end of the belt, and 1 represents the maximum width of the tread, still measurable as distance between the said edges.

In particular, for the pneumatic tyres of the invention the value of the above said arrow "f" is comprised between 0.20 and 0.35.

In its most general line the plant for manufacturing the above mentioned pneumatic tyres is still conveniently that described in the Italian patent No. 1,099,513 (or in the subsequent Italian patent No, 1,133,894 concerning an improvement apt to give it a greater productivity), except for the amendment which will be explained hereinafter, in accordance with the present invention, so that it is unnecessary to supply here a complete description.

With reference to figure 4, herewith enclosed, it is sufficient to remember that the above said plant comprises a main drum 10 for building-up the carcass 1 according to a cylindrical configuration and/or its shaping according to a toric configuration, an ancillary drum 11 for building-up (in accordance with the present invention) an annular element comprising the belt and the tread band radially superimposed upon the latter, at first in cylindrical configuration (in flat configuration) and subsequently for shaping the above said annular element in its final toric configuration, substantially corresponding to that of the vulcanized tyre, means 12 for transporting the so shaped annular element from the ancillary drum 11 to the main drum 10 so as to assemble the carcass to the annular element, through the expansion of the carcass against the corresponding inner surface of the above said annular element.

For a better understanding, it is briefly called to mind that the ancillary drum 11 is formed by two distinct coaxial parts 111, 112 preferably axially separable from each other, integral to each other in the rotation when they are mutually coupled, freely rotating the one with respect to the other when they are separated.

One of the two parts, constituting the well known "comb drum" 111, is formed by a plurality of teeth 14, circumferentially spaced from each other and arranged in such a way as to constitute a predetermined diameter cylindrical surface; the other part 112, radially expansible, is formed by a plurality of metal sectors 13 (figure 5) shaped according to a radially outer profile 13', novel with respect to the known plant, substantially corresponding to the toric profile at high transversal curvature of the finished pneumatic, or better, of the radially inner surface of the above said pneumatic tyre.

The shape of said profile can be conveniently identified by its "swelling ", i.e. by the ratio a/b where "a" represents the maximum height of the curvilinear part of said profile, substantially coinciding with the toric profile of the finished tyre, and "b" represents its maximum width, i.e. the distance between the two ends, as clearly shown in figure 5.

Said swelling is kept conveniently equal to the arrow of the tyre that is being made and consequently

has the same value comprised between 0.20 and 0.35.

After the plant, the working process in accordance with the invention carried out for building-up the annular element that will be assembled to the carcass, is now explained with the aid of the figures 6 and 7, where the process of the invention is shown in the sequence of the operative steps in comparison with those carried out according to the known process of the art.

At first the ancillary drum is put under rotation in order to wind on the comb-shaped part, one after the other, the two reinforcing layers 6 and 7, splicing for each of them the opposite ends. Contrary to what happened in the process of the art according to which the above said layers were immediately shaped (figures 6a, 6b, 6c), now the tread band is wound, possibly also pressing it slightly against the above said reinforcing annular layers (figure 7a).

After having brought the expansible drum into the comb drum (figure 7b), by setting in action a suitable control, the sectors expand through the spaces of the comb teeth until said sectors support by themselves the annular element comprising the reinforcing layers and the tread band; it is clear that in this way the annular element loses the cylindrical shape to gain a toric configuration corresponding to that of the supporting sectors, and therefore to that of the finished pneumatic tyre (figure 7c).

In this step the reinforcing cords of the layers effect a scissors movement that produces an angular variation of their inclination with respect to the tyre mid-plane: more exactly their inclination reduces in a not uniform manner along the development of the cords, in relation to the entity of the radial expansion suffered point by point and to the initial value of said inclination angle.

For example in the tyre prototype realized by the Applicant and shown herein, the above said cords, arranged on the comb drum (figure 2) symmetrically according to an angle "w" of 30°, in each layer, in the vulcanized tyre are arranged according to an angle "x" equal to 18° at the mid-plane and according to an angle "y" of 20° at the ends of the belt, with a continuous variation of the value of the inclination angle along the longitudinal development of the cords, with a difference of about 2° between the values of the angles between the mid-plane and the ends of the belt.

More generally, said angular variation (w-x) is preferably not less than 5° and not greater than 15°, so that in the finished pneumatic tyre the reinforcing cords of the belt layers are arranged according to an angle smaller than that when laid on the comb drum; besides the value of said angle is less at the mid-plane than the value at the ends: said difference (y-x) is conveniently comprised within a maximum value of 5°.

During the radial expansion of the sectors 13 (figure 4) the drum 112 is unthreaded from the comb drum 111, releasing the same from the rotation, so as to make this latter immediately available for the beginning of another belt building cycle, and fitting the device 12 around the above said expansible drum 112 (figure 7d).

Now in a known manner, the transporting means 12 withdraw the annular element (figure 7a) through the contraction of the sectors 13, then the annular element is transferred onto the main drum, in coaxial position and in correspondence of its mid-plane (figure 7f), around the carcass previously arranged in cylindrical form on the main drum, in a way functionally independent of the cited steps, and possibly already shaped in part; subsequently, the carcass is further shaped in a toric configuration against the radially innermost layer of the annular element in order to assemble the two parts of the pneumatic tyre: finally the complete tyre is withdrawn from the main drum and sent to the vulcanizing step inside the mould.

The so realized pneumatic tyre before being removed from the main drum can be subject to a stitching operation carried out with known disc devices to obtain a strong adhesion of the elements assembled together and the elimination of possible air bubbles remained entrapped during the assembling step.

It is clear that the above said fixed disc device at this stage of the process is not able to cause any one of the above said deformations of the pneumatic tyre structure.

Also it is to be notified that by means of the process according to the invention the pneumatic tyre reaches its final configuration formerly on the building machine, so that in the mould it suffers only a slight "dilatation", i.e. a further expansion of the carcass, necessary for vulcanizing the pneumatic tyre with the belt in an initial tension state (pre-tension), measurable as an increase of the circumferential development of the pneumatic tyre, at most of the order of 1,5%, that is not sufficient to change the toric configuration of the same.

A pneumatic tyre manufactured according to the steps of the present invention achieves surprisingly better results.

Firstly the tread band is torically shaped together with the reinforcing annular structure and not subsequently to the shaping of the same and on the same, and said shaping takes place in consequence of the radial expansion of a suitable supporting surface that makes it possible for the rubberized fabric layers laid herein, and for the tread band all those restriking movements produced by the passage of the annular

element from a cylindrical configuration of a given diameter to a toric configuration of greater diameter.

Moreover the carcass is shaped torically and definitively against the annular element already torically shaped in its final form and not viceversa.

This operation of adapting perfectly the carcass to the final profile of the reinforcing annular element reduces considerably for the above said annular element the stretching due to the strong adaptation action that, during the stitching step, said element had to suffer during the assembling to the carcass.

In fact, in this way having eliminated the stitching of the tread band on the reinforcing annular structure (figures 6d, 6e) already torically shaped, as well as the shaping of the reinforcing structure already assembled to the shaped carcass, all those uncontrollable deformations of the structural geometry of the pneumatic tyre inciding particularly on the arrangement of the carcass and belt reinforcing cords have been avoided. Said deformations limited qualitatively the performance of the pneumatic tyres forming the object of the present invention.

This result drops the known technical prejudice according to which it was not possible to obtain a uniform and homogeneous expansion of the reinforcing annular element in the presence of the tread band before its assembling to the carcass since the presence of the tread hampered the movement of the reinforcing cords during the shaping of the belt layer, altering the final tension state of the above said cords with the consequent reduction of the tyre resistance in particular to the lateral and torsional stresses.

Also the elimination of the step of the final shaping inside the mould has produced a further benefit as regards the maintenance of the planned structural characteristics of the pneumatic tyre during the building up process and consequently the quality of the finished tyre.

In fact it is known that a reinforcing annular structure not corresponding to the uniformity and evenness characteristic in particular as regards the belt angles, compromises the handling characteristics of the tyre, i.e. lowers the level of the performance in respect of steering response, lateral stability and insensitiveness to the road roughness, causing the instability of the vehicle.

To sum up, manufacturing a pneumatic tyre in accordance with the process of the invention, the angular arrangement of the carcass cords does not suffer any alteration, while that of the belt cords changes in a uniform, regular, continuous manner at a controlled speed and not as a sequence of pulses (as in the case of the carcass/belt assembly shaping, where said angular variation is hampered by the friction with the carcass ply) or for imposed deformation, as in the presence of the stitching of the tread band on the belt, assuring therefore the conformity of the tyre to the plan conditions and the qualitative level of the finished tyre.

In confirmation of the above, sectioning the vulcanized tyre obtained with the process according to the invention those phenomena of wavings, lack of parallelism, wrong angulations and lying unevenness of the carcass and belt reinforcing cords are no more meet as instead happens in the pneumatic tyres manufactured with the known processes and apparatuses.

In order to value the qualitative improvements achieved by means of the tyres manufactured according to the process of the invention, two different series of tests, on road and on track respectively, have been carried out, comparing the pneumatic tyres of the invention at first (road tests) with those produced by the Applicant, according to the previous process already cited in the Italian patent No. 1,099,513, and then (track tests) with equivalent tyres produced by other manufacturers, in extreme conditions.

The characteristics of the vehicle used are the following ones:

MOTORCYCLE YAMAHA FRZ 1000	
Front tyre	size 120/70 ZR 17
inflation pressure	2.5 bar
rim	3.50 - 17
Rear tyre	size 160/60 ZR 18
inflation pressure	2.9 bar
rim	4.50 - 18

The road test consisted in valuing the qualitative level of the more important handling characteristics especially depending on the reinforcing annular structure, giving a vote (from 0 to 10) to each one of the

considered characteristics.

Table 1 gives the result of the comparison between the pneumatic tyres of the invention (type A) and those manufactured by the same Applicant according to the old process (type B) referred to above.

TABLE 1

TESTS/TYRES	type A	type B
SHIMMY	7	4
HANDLING	6.5	4.5
SPEEDY RESPONSE	6	4.5
STEERING STABILITY	7	6
DRY ROAD HOLDING	7	6.5
COMFORT	6	5.5
MEAN VOTE	6.65	5.14

The track test that has considered other characteristics more specifically connected to the type for agonistic use, has been carried out by comparing two different types of pneumatic tyres manufactured according to the process of the invention, with equivalent tyres (i.e. homologated for the same type of use and vehicle YAMAHA) of the best brands sold on the market.

Here it is to be noted that the tested characteristics are not the structural characteristics of the different compared tyres, that are not known, by only their global behaviour influenced by all the characteristics of the final product: for instance the tyre of the invention is lighter (about 1.5 kg., with all the advantages achieved) than the compared tyres.

Moreover the purpose of the test was that of valuing the global effect of the invention in comparison with the better equivalent pneumatic tyres available on the market.

A vote has been allotted to each one of the examined characteristics, after that the arithmetical mean of the global vote achieved by each type of tyre has been calculated.

TABLE 2

TYRES	MEAN VOTE
TYRE OF THE INVENTION (1st version)	7
TYRE OF THE INVENTION (2nd version)	6.8
TYRE A	6.8
TYRE B	6.65
TYRE C	6.2
TYRE D	6
TYRE E	5.5

Table 2 gives the result of said comparison, being the tyres of the other manufacturers indicated with A, B, C, D, and E. The improvement achieved by the tyres according to the invention with respect to those of the art appears immediately clear.

Finally it is stressed that the apparatus and the process in accordance with the invention have been

described according to an example of preferred embodiment and of particularly advantageous construction so that it is clear that the present invention includes all those modifications and variants, even if not explicitly described herein, however easily deducible from the present inventive idea by the skilled in the art.

Claims

1. Process for manufacturing pneumatic tyres having a toric profile at high transversal curvature, provided with a carcass (1), a tread band (4) put as a crown on said carcass and a reinforcing annular structure (5), interposed between said carcass and said tread band (in particular radially superimposed layers (6, 7) of rubberized fabric provided with reinforcing cords (8) inclined with respect to the circumferential direction of the pneumatic tyre, parallel to each other in any layer and crossing those of the adjacent layers), said process comprising the steps of preparing separately the one from the other said carcass, said tread band and said reinforcing annular structure, of associating to said carcass an annular element comprising said reinforcing annular structure and said tread band, assembled together and already torically shaped, realizing in such a way a complete green pneumatic tyre and of vulcanizing said green pneumatic tyre inside the mould, said process being characterized by the fact of:
   - assembling said tread band (4) to said reinforcing annular structure (5) before the shaping step, so as to have said annular element in a cylindrical configuration, and
   - shaping said annular element to its final toric configuration, at high transversal curvature, before being assembled to said carcass.

2. Process according to claim 1 characterized by the fact that during said toric shaping of said annular element to the final configuration, the inclination angle (10) of said reinforcing cords with respect to the circumferential direction of the pneumatic tyre changes along the development of the cords.

3. Process according to claim 2, characterized by the fact that in consequence of said toric configuration the inclination angle (10) of said cords along their longitudinal development decreases of a value comprised between 5° and 15°.

4. Process according to claim 2, characterized by the fact that in consequence of said toric configuration the inclination angle (y) of said cords at the ends of said reinforcing annular structure differs from the angle (x) at the mid-plane of a value not greater than 5°.

5. Process according to claim 1, characterized by the fact of subjecting said reinforcing annular structure (5), shaped in its final configuration, to a further dilatation, not greater than 1.5% of its circumferential development, through the expansion of the green tyre inside the vulcanizing mould.

6. Pneumatic tyre for vehicle wheels, of the type having a toric profile at high transversal curvature, provided with a carcass (1), a tread band (4) put as a crown on said carcass and a reinforcing annular structure (5), interposed between said carcass and said tread band (comprising radially superimposed layers (6, 7) of rubberized fabric provided with reinforcing cords (8) inclined with respect to the circumferential direction of the pneumatic tyre, parallel to each other in any layer and crossing those of the adjacent layers, characterized by the fact that the inclination angle (w) of said reinforcing cords, in the vulcanized pneumatic tyre is comprised between 10° and 35°, the value of said angle at the mid-plane being lower than the value taken on at the ends of said reinforcing annular structure.

7. Machine for manufacturing pneumatic tyres having a toric profile at high transversal curvature, provided with a carcass (1), a tread band (4) put as a crown on said carcass and a reinforcing annular structure (5), interposed between said carcass and said tread band, said machine comprising a main drum (10) for shaping a carcass of cylindrical configuration into a toric configuration, an ancillary drum (11) for building-up and shaping said reinforcing annular structure, said ancillary drum (11) comprising a cylindrical drum (111) of predetermined diameter for building-up said annular structure according to a cylindrical configuration and an expansible drum (112) for the subsequent toric configuration of said annular structure, said expansible drum (112) comprising a plurality of sectors (13) having a radially outer toric profile, movable in radial direction for coupling with the radially inner surface of said annular structure, and for its toric configuration, and means (12) for transferring at least said reinforcing annular structure (5) from said expansible drum (112), coaxially around said carcass, onto said main drum (10),

said machine being characterized by the fact that said radially movable sectors (13) have said outer profile substantially corresponding to the toric profile at high transversal curvature of the radially inner surface of the vulcanized pneumatic tyre.

8. Machine according to claim 7, characterized by the fact that the radially outer toric profile of said sectors has a swelling comprised between 0.20 and 0.35.

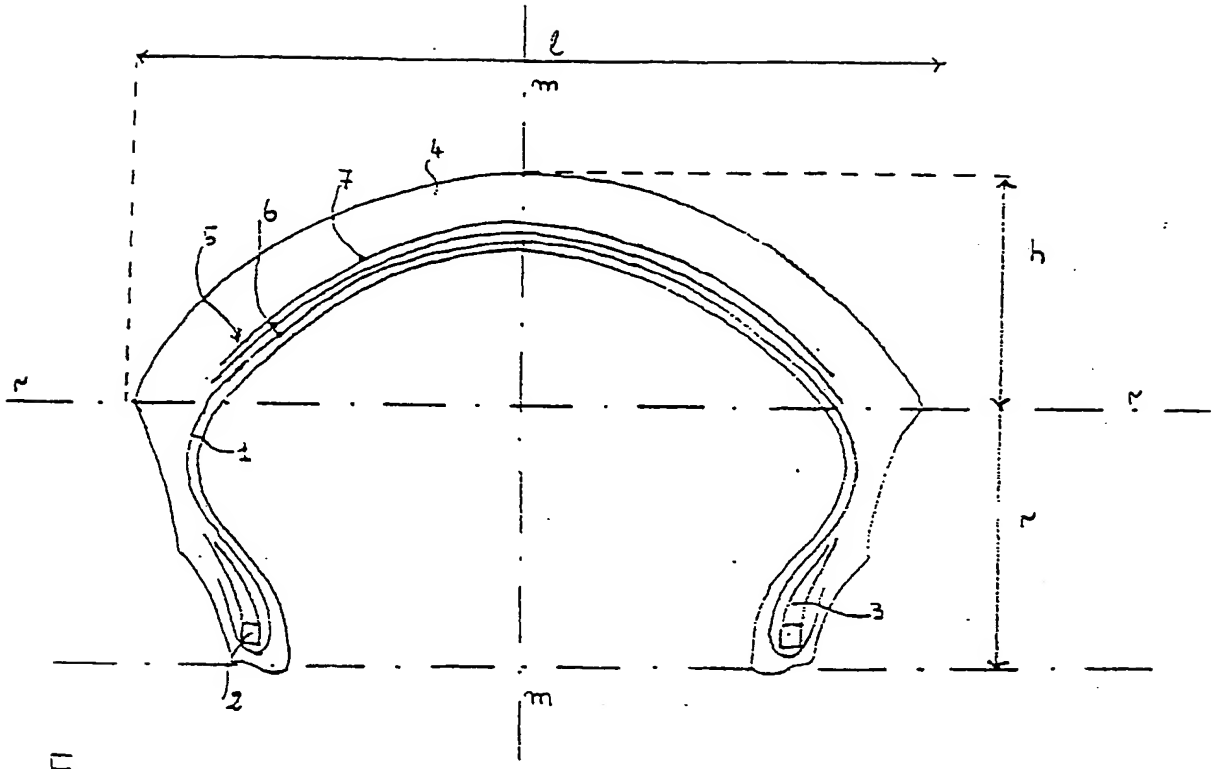

Fig. 1

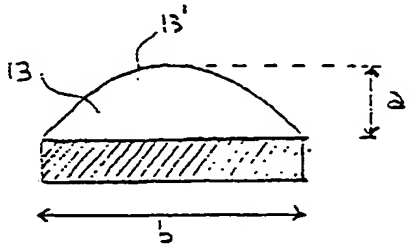

Fig. 5

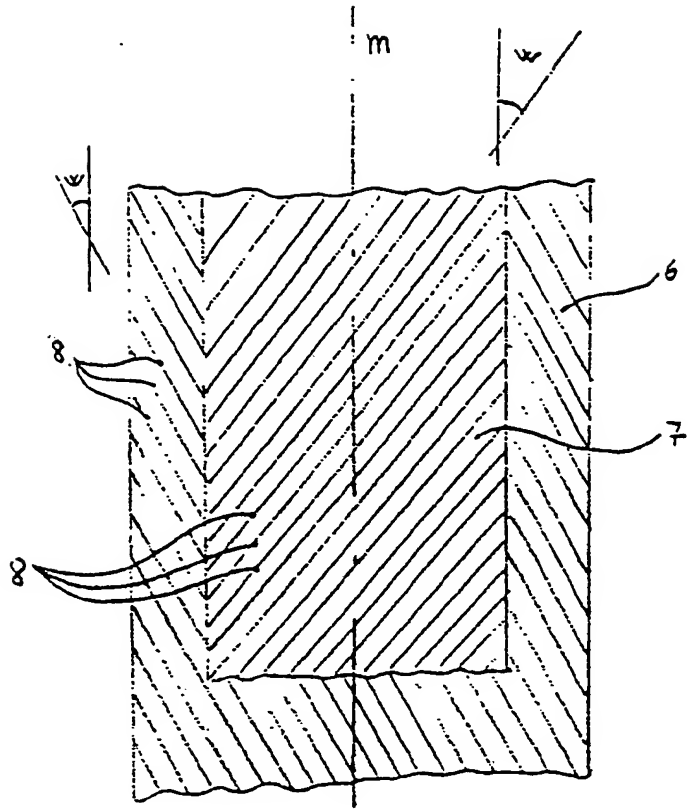

Fig. 2

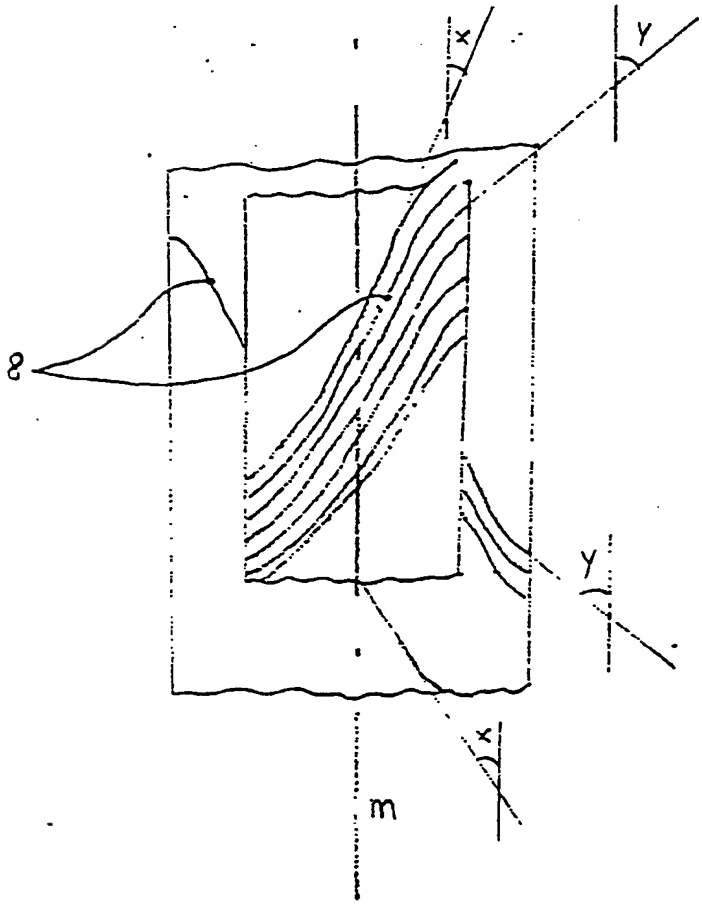

Fig. 3

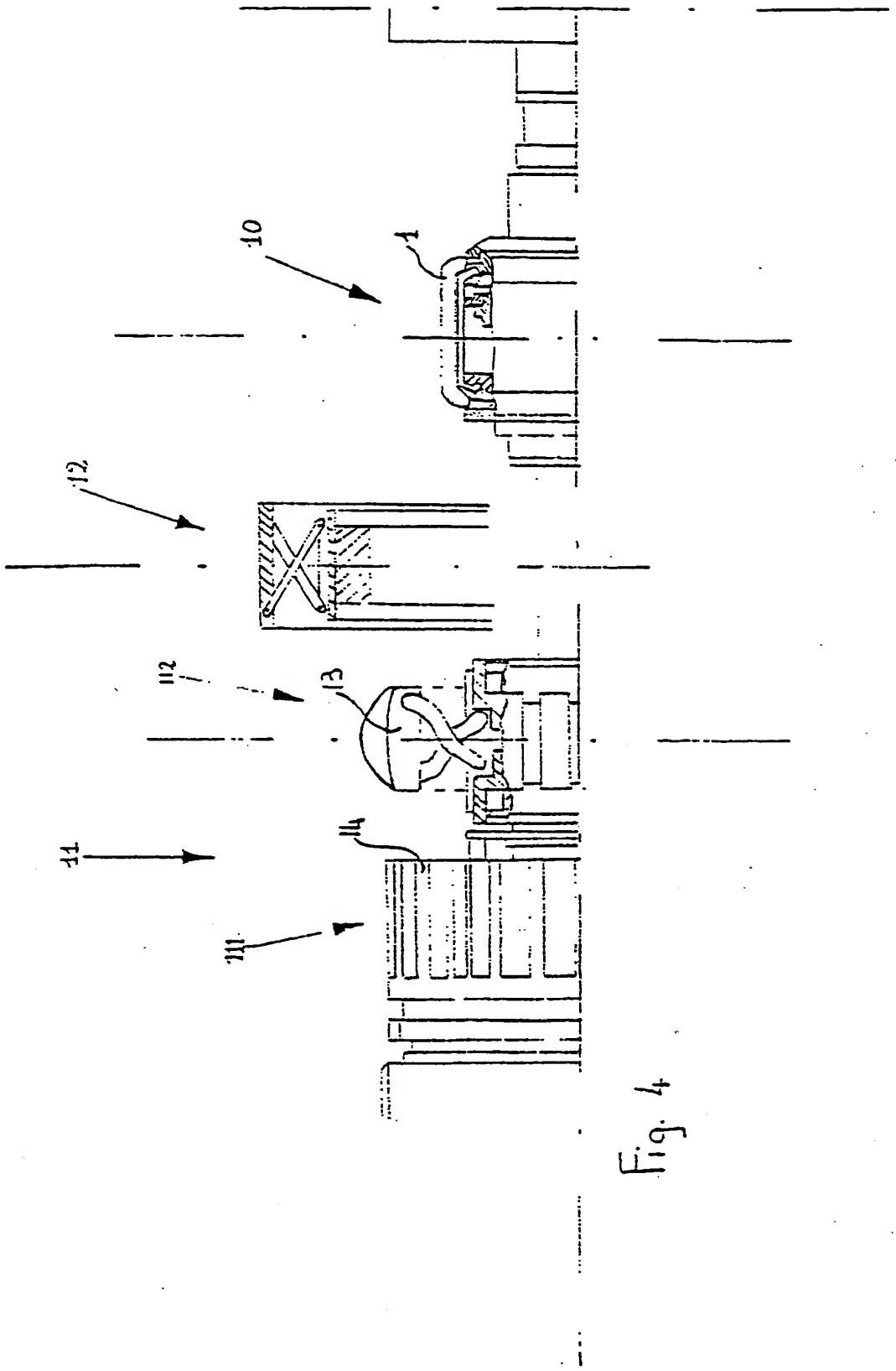

Fig. 4

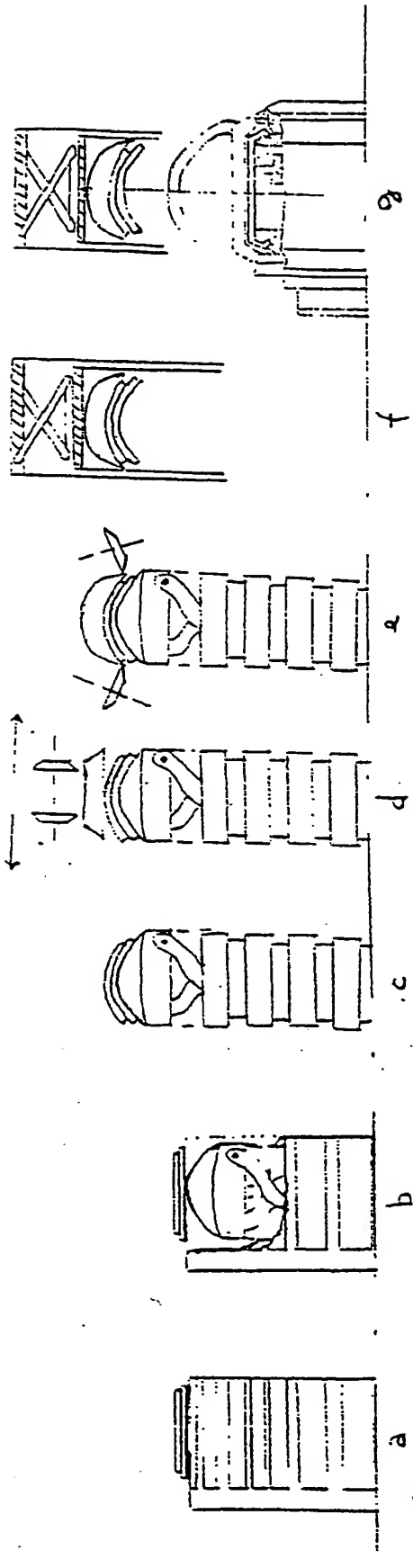

Fig. 6

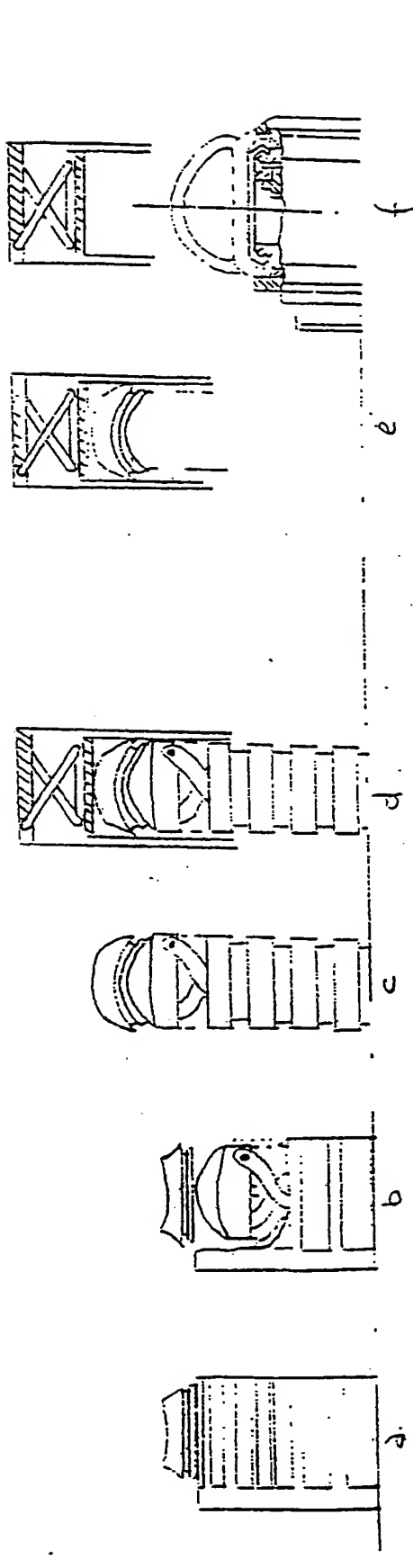

Fig. 7

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 433 974 A3**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **90124573.8**

(51) Int. Cl.5: **B29D 30/36**

(22) Date of filing: **18.12.90**

(30) Priority: **19.12.89 IT 2273089**

(43) Date of publication of application:
26.06.91 Bulletin 91/26

(84) Designated Contracting States:
AT BE CH DE DK ES FR GB GR LI LU NL SE

(88) Date of deferred publication of the search report:
19.11.92 Bulletin 92/47

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(54) Method and apparatus for making tyres having a high transversally curved toric profile.

(57) The invention refers to the manufacture of a pneumatic tyre having a toric profile at high transversal curvature wherein the reinforcing annular structure (5) and the tread band (4) are shaped together, starting from a cylindrical configuration to the final toric profile, in a single shaping step, before being assembled to the carcass, the step for vulcanizing the pneumatic tyre being carried out without requiring a further shaping of the pneumatic tyre.

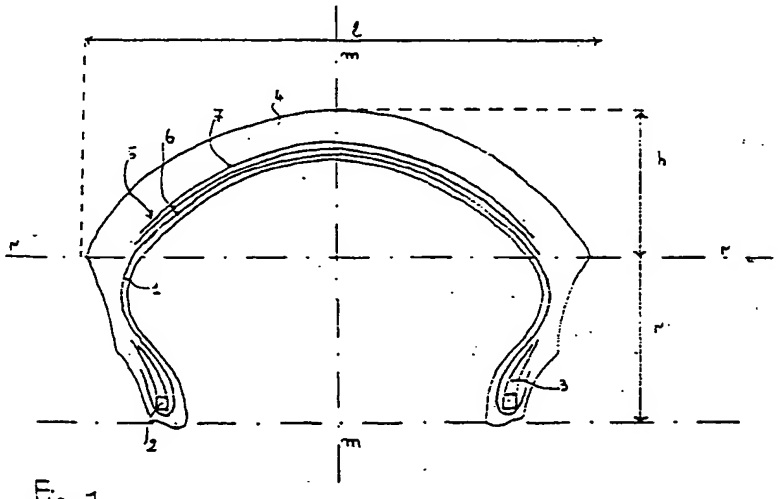

Fig. 1

EP 0 433 974 A3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 90 12 4573

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
P,A	GB-A-2 223 988 (APSLEY METALS) * page 1, line 13 - page 2, line 21 * * page 5, line 1 - page 6, line 12 * * page 11, line 23 - page 13, line 21 * * figures 1,2,6 *	1,7	B29D30/36
A	GB-A-2 031 818 (INDUSTRIE PIRELLI SPA) * the whole document *	1,7	
A	GB-A-485 401 (DUNLOP RUBBER COMP.) * the whole document *	7	
A	DE-A-2 430 495 (CONTINENTAL GUMMI WERKE) * page 4, line 13 - line 22; figures 1-3 *	3	
A	US-A-4 770 222 (SOCIETA' PNEUMATICI PIRELLI) * column 3, line 59 - column 4, line 11; figure 1 * * column 4, line 62 - line 68; figure 1 *	6,8	
A	EP-A-0 346 047 (SUMITOMO RUBBER IND.) * column 1, line 27 - line 48; figure 2 *	8	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B29D
B60C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	11 SEPTEMBER 1992	FREGOSI A.M.

CATEGORY OF CITED DOCUMENTS

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